

CERTIFICATE OF MAILING

I hereby certify that this UTILITY PATENT APPLICATION TRANSMITTAL and the documents referred to as attached therein are being deposited on the below date with the United States Postal Service in an envelope as "Express Mail Post Office to Addressee", Express Mail Label No. EL370105765US, addressed to: Box Patent Application, Assistant Commissioner for Patents, Washington, DC 20231:

Date:

May 12/1999

Printed Name: Stephanie Klapp

Signature: Stephanie Klapp

jc525 U.S. PTO

09/310800

05/12/99

UTILITY PATENT APPLICATION TRANSMITTAL

Address to:

BOX PATENT APPLICATION
Assistant Commissioner for Patents
Washington, DC 202031

Attorney Docket No.: 96-017-TAX

Inventor: Yi-Shung Chaug

1. This application entitled APPARATUS FOR SECURING A THIN FILM MAGNETIC TAPE HEAD CLOSURE USING GLUING VIAS is a divisional under 37 C.F.R. § 1.53(b) of prior application Serial No. 08/846,864 filed on May 1, 1997, entitled APPARATUS FOR SECURING A THIN FILM MAGNETIC TAPE HEAD CLOSURE.

Application elements and other attached papers:

2. ☒ Specification and Claims (3 pages)
3. ☒ Abstract (1 page)
4. ☒ Drawings (formal) (6 sheets)
5. ☒ Declaration
6. ☒ Incorporation by reference: The entire disclosure of the prior application, from which a copy of the oath or declaration is supplied under Item 5, is considered as being part of the disclosure of the accompanying application and is hereby incorporated by reference therein.
7. ☒ Preliminary Amendment:

A Preliminary Amendment is attached.

Cancel in this application original claims 2, 7 and 15 of the prior application before calculating the filing fee.

Please amend the specification by inserting before the first line the sentence:

"This is a divisional of copending application Serial No. 08/846,864 filed on May 1, 1997."

8. ☐ An Information Disclosure Statement (IDS) is attached, along with the following indicated attachments thereto:
- Form PTO/SB/08 (___ sheets)
9. ☒ An Assignment of the invention to Storage Technology Corporation was recorded May 1, 1997, at Reel 8704, Frame 0698.
10. ☒ The power of attorney in the prior application is to Timothy R. Schulte, Reg. No. 29,013. The power appears in the original papers in the prior application. An Associate Power of Attorney is attached with this application.
11. ☒ Correspondence address: Please address all future communications to:
- Wayne P. Bailey
Storage Technology Corporation
One StorageTek Drive, MS-4309
Louisville, Colorado 80028-4309
Telephone: 303-673-8223; Fax: 303-673-4151.
12. ☒ Request to Charge Fee to Deposit Account
13. ☒ Acknowledgment of Receipt Card.

CLAIMS AS FILED				
FOR	NUMBER FILED	NUMBER EXTRA	RATE	BASIC FEE
				\$760.00
Total Claims	17 - 20		x \$18.00	\$ 0.00
Independent Claims	4 - 3	1	x \$78.00	\$ 78.00
Assignment Recording Fee				\$ 0.00
TOTAL FEE:				\$838.00

- ☒ The Commissioner is hereby authorized to credit overpayments or charge the following fees (or any deficiency therein) to Storage Technology Corporation Deposit Account No. 19-4545:
- a. Fees required under 37 C.F.R. §1.16.
- b. Fees required under 37 C.F.R. § 1.17.

☒ Two additional copies of this sheet are enclosed.

Respectfully submitted,

Date:

May 12, 1999

Name: Wayne P. Bailey
Registration No.: 34,289
Attorney of Record

Storage Technology
2270 South 88th Street
Louisville, CO 80028-4309

Sherree-Juli
Attorney Docket No. 96-017-TAP
Date: May 1, 1997

Assistant Commissioner for Patents
Washington, D.C. 20231

BOX PATENT APPLICATION

Re: Title: Method and Apparatus For Securing A Thin Film Magnetic Tape Head
Closure
Applicant: Yi-Shung Chaug
U.S. Serial No.:
Filing Date: May 1, 1997
Group Art Unit:

Sir:

Enclosed are:

1. ☒ Specification and Claim(s).
2. ☒ Abstract
3. ☒ Request to Charge Fee to Deposit Account
4. ☒ Five (5) sheets of informal drawings.
5. ☒ An Assignment of the invention to: Storage Technology Corporation with Recordation Form Cover Sheet
6. ☐ Information Disclosure Statement.
7. ☒ Declaration and Power of Attorney.
8. ☒ Acknowledgment of Receipt Card.
9. ☐ OTHER:

- (1) Notice to file Missing Parts of Application Filing Date Granted.
- (2) Authorization to charge Deposit Account for filing fee.

CLAIMS AS FILED				
FOR	NUMBER FILED	NUMBER EXTRA	RATE(\$)	BASIC FEE
				\$770.00
Total Claims	16 - 20	0	x \$22.00	\$0.00
Independent Claims	3 - 3	0	x \$80.00	\$0.00
Assignment Recording Fee				\$40.00
TOTAL FEE				\$810.00

- ☒ Please charge Deposit Account No. 19-4545 in the amount of \$810.00.
- ☒ The Commissioner is hereby authorized to charge any additional fees which may be required or credit any overpayment to Deposit Account No. 19-4545.
- ☒ Two additional copies of this sheet are enclosed.

Timothy R. Schulte
 Registration No. 29,013
 (303) 673-5989


 Attorney

Enclosures

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of:

YI-SHUNG CHAUG

Divisional of Serial No. 08/846,864,
Filed May 1, 1997

For: APPARATUS FOR SECURING A THIN FILM MAGNETIC TAPE HEAD CLOSURE
USING GLUING VIAS

Attorney Docket No. 96-017-TAX

PRELIMINARY AMENDMENT

BOX PATENT APPLICATION
Assistant Commissioner for Patents
Washington, D.C. 20231

Sir:

Please amend the above-identified patent application, which is a divisional of U.S. Patent Application Serial No. 08/846,864, filed May 1, 1997, as follows:

In the Title:

After "Closure", insert --Using Gluing Vias--.

In the Claims:

1. (Amended) A magnetic [recording] head for at least one of reading from and writing to a medium moving across the head, comprising:

a substrate;
a closure separated from said substrate by a gap, said closure including a C-core;
a thin film layer deposited on said substrate, said thin film layer comprising a recording track layer; and

[one or more] a plurality of gluing vias [trenched in a side surface of either or both of] formed between said substrate and said closure.

Cancel Claim 2 without prejudice or disclaimer.

S/N: Divisional of Serial No. 08/846,864,
Filed May 1, 1997

Attorney Docket No. 96-017-TAX

3. (Amended) A magnetic [recording] head according to claim [2] 1, wherein said recording track layer comprises at least one of a read track and a write track.

4. (Amended) A magnetic [recording] head according to claim 3, wherein at least one of said gluing vias are trenched on said side surface of said substrate between said at least one of a read track and a write track.

5. (Amended) A magnetic [recording] head according to claim 1 wherein said gluing vias are photolithographically defined and subsequently trenched on said side surfaces.

6. (Amended) A magnetic tape head for reading from and writing to a magnetic tape moving across the head, comprising:

- a substrate having a gap side surface;
- a closure having a gap side surface that opposes and is separated from said gap side surface of said substrate by a gap;
- a thin film layer deposited on said gap side surface of said substrate in said gap, wherein said thin film layer comprises a recording track layer and has a nonplanar topography along said gap;
- [one or more] a plurality of gluing vias [on either or both of] formed between said substrate and said closure; and
- adhesive in said gap and said gluing vias.

Cancel Claim 7 without prejudice or disclaimer.

8. (Amended) A magnetic tape head according to claim [7] 6, wherein said recording track layer comprises at least one of a read track and a write track.

9. (Amended) A magnetic tape head according to claim 8 wherein at least one of said gluing vias are trenched on said side surface of said substrate between said at least one of a read track and a write track.

10. (Amended) A magnetic [recording] tape head according to claim 6 wherein said gluing vias are photolithographically defined and subsequently trenched on [one or both] at least one of said gap side surfaces of said substrate and said closure.

11. (Amended) A method of manufacturing a multi-track tape head for at least one of reading from and writing to a medium, comprising the steps of:

depositing a recording track layer on a substrate;

forming a C-core in a closure;

trenching gluing vias on a gap side surface of [either or both] at least one of said substrate and [a] said closure; and

bonding said substrate and said closure together by introducing adhesive into said C-core and said gluing vias.

12. A method according to claim 11, wherein said step of forming said recording track comprises forming at least one of a read track and a write track on said substrate.

13. A method according to claim 11, wherein said step of trenching includes the step of photolithographically defining said gluing vias.

14. (Amended) A method according to claim 11 [further including] wherein the step of forming a C-core includes the step of [machining a] forming said C-core on said gap side surface of said closure.

Cancel Claim 15 without prejudice or disclaimer.

16. (Amended) [A method according to claim 11] A method of manufacturing a multi-track tape head for at least one of reading from and writing to a medium, comprising the steps of:

depositing a recording track layer on a substrate;

forming gluing vias on a gap side surface of at least one of said substrate and a closure, wherein at least one of said gluing vias are trenched on said side surface of said substrate between a read track and a write track on said recording track layer; and

bonding said substrate and said closure together by introducing adhesive into said gluing vias.

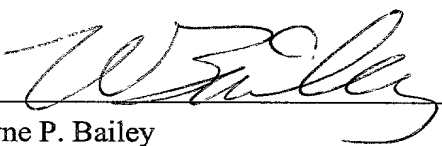
Add Claim 17. The method of Claim 16 further comprising the step of forming a C-core on said gap side surface of said closure.

Add Claim 18. The method of Claim 17 wherein said step of bonding includes the step of introducing said adhesive into said C-core.

Add Claim 19. The magnetic head of Claim 1 formed in accordance with the method of Claim 11.

Add Claim 20. The magnetic head of Claim 1 wherein at least a portion of said plurality of gluing vias intersects said C-core.

Respectfully submitted,
YI-SHUNG CHAUG

By: 
Wayne P. Bailey
Registration No. 34,289
Attorney for Applicant

Date: May 12, 1999
STORAGE TECHNOLOGY CORPORATION
One StorageTek Drive, MS-4309
Louisville, Colorado 80028-4309
(303) 673-8223

METHOD AND APPARATUS FOR SECURING A THIN FILM MAGNETIC TAPE HEAD CLOSURE

Background of the Invention

1. *Field of the Invention*

The invention relates to the field of dynamic magnetic information storage and retrieval. More particularly, the invention relates to a magnetic recording head. In still greater particularity, the invention relates to a method and apparatus for securing a closure to a recording module. By way of further characterization, but not by way of limitation thereto, the invention utilizes gluing vias in the closure and or in the recording module to strengthen the bond therebetween.

2. *Description of the Related Art*

There has been a great demand for increasing the data throughput of magnetic tape transport systems used in conjunction with high-speed digital computers. In order to utilize the high-speed capabilities of these computers, it is necessary to increase the amount of data stored on a magnetic tape and to increase the speed at which the data is written to or retrieved from the magnetic tape media.

To increase the data storage capacity of the tape transport systems, the areal density of the magnetic tape media which stores the data must be increased. Areal density is defined as the number of units of data stored in a unit area of the tape. Areal density is characterized by two attributes: linear density and track density. To increase the areal density of a magnetic tape media, one must increase either or both, the linear density and track density of the magnetic tape.

Track density is defined as the number of data tracks per unit width of magnetic tape. Two characteristics associated with track density are track width, defined as the actual width of an individual data track; and track pitch, defined as the distance from the center of one data track to the center of a neighboring data track. As magnetic tape head size decreases, the track pitch and track width are decreased, thereby increasing track density.

With high track density magnetic recording heads such as in the 36-track system, because the distance between data tracks is reduced, slight imperfections in the heads will have a more

significant impact on the performance and/or the quality of the tape heads. Naturally, a small imperfection in a small area will have a greater impact and be more significant than the same small imperfection in a larger area.

5 In magnetic recording heads, especially magneto-resistive thin-film tape heads, a gap length between a substrate and a closure is one of the critical parameters in determining the recording performance of the tape head. Bonding the closure and the recording module affects the gap which is critical to the performance of the head. When an adhesive is introduced between the recording module and the closure, an insufficient bond will result in a condition known in the art
10 as "gap slip". Gap slip allows shifting of the closure with respect to the recording module and results in significant yield problems in tape head manufacturing. The occurrence of gap slip during head operation would also deteriorate the head recording performance and head life.

15 The substrate has read and/or write tracks deposited on and extending from a gap side surface of the substrate to form the recording module which has a nonplanar topography due to the deposition of the structured thin film layers. The recording module is bonded to the flat surface on the closure. After bonding the closure and the recording module, the tape head is ground and lapped such that a smooth contoured surface is obtained.

Summary of the Invention

20 The invention utilizes gluing vias in the closure surface and/or the recording module surface to increase bonding strength of the closure to the recording module to thereby improve tape head
25 performance and longevity. The tape head of the present invention has a substrate and a closure separated by a gap. The surface of the recording module has a nonplanar topography along a gap side surface which creates localized air space in the gap. When adhesive is introduced between the closure and the recording module, the adhesive flows into these air spaces to bond the surfaces. The invention utilizes gluing vias in the surfaces of the closure and/or the recording
30 module to increase flow of the adhesive between these surfaces and improve bonding strength.

The present invention further relates to a method of making a multi-track tape head for at least one of reading from and writing to a medium. The method comprises the steps of: (1) forming

a recording track on a substrate, whereby the substrate has a first nonplanar topography along a gap side surface of the substrate; (2) adding gluing vias on the substrate and/or the closure; (3) machining a C-core on a gap side surface of the closure; and (4) bonding the substrate and the closure together by introducing adhesive into the C-core.

The present invention overcomes the problems associated with gap slip and increases manufacturing yield. The present invention also reduces or eliminates performance problems and reduced head useful life due to gap slip.

Brief Description of the Drawings

The present invention will be described with reference to the accompanying drawings:

FIG. 1 is a cross-sectional view of the magnetic tape head and medium in accordance with the present invention;

FIG. 2 is an isometric view of the magnetic head of the present invention where the closure is separated from the substrate;

FIG. 3 is a view of side surface 18 of the substrate including gluing vias according to the present invention;

FIG. 4 is a view of side surface 19 of the closure including gluing vias according to the present invention; and

FIG. 5 shows steps for producing a tape head in accordance with the present invention.

Description of the Preferred Embodiment

The invention relates to a magnetic tape head 10 as shown generally in cross section in FIG. 1. Tape head 10 includes a closure 12 and a substrate 14 separated by a gap 15. A medium such as a magnetic recording medium or a magnetic tape 11 passes over a front end 16 of tape head 10. A magnetic field at front end 16 of gap 15 enables data to be read from and

should not be limited to these dimensions or spacing. Of course, it may also be desirable to include vias on both surfaces 18 and 19 to increase bonding strength.

FIG. 5 illustrates the steps of manufacturing tape head 10 in accordance with the present invention. In step 32, a recording track layer 16 is deposited and patterned in accordance with conventional thin film deposition techniques such as vacuum deposition to form read tracks 28 and/or write tracks 29. Of course, read tracks 28 and write tracks 29 may be deposited on substrate 14 either before or after closure 12 is manufactured in accordance with the present invention. In step 33, gluing vias are photolithographically defined and subsequently trenched in either or both the substrate and closure. In step 34, the C-core is machined on the closure surface. Finally, in step 35, the closure and substrate are bonded together with adhesive introduced into the C-core. In accordance with the invention, the adhesive flows into the gluing vias thereby increasing the bond strength of the tape head.

While advantageous embodiments have been chosen to illustrate the invention, it will be understood by those skilled in the art that various changes and modifications can be made therein without departing from the scope of the invention as defined in the appended claims. For example, although tape head 10 has been referred to as a magnetic recording tape head, it is within the scope of the invention to utilize the techniques of the present invention in other types of heads. Similarly, although tape head 10 is of an interleaved type where read tracks 28 are interleaved with write tracks 29, a read tape head having read tracks 28 only or write tracks 29 only may advantageously employ the present invention. Furthermore, although read tracks 28 and write tracks 29 are shown as the type that are deposited on gap side surface 18 of substrate 14, it is within the scope of the invention to have gap side surface 18 configured to receive recessed read tracks 28 and/or write tracks 29. In addition, while certain dimensions and spacing for gluing vias are disclosed in the preferred embodiment, the invention should not be limited to such dimensions and spacing as the claimed method and apparatus may be advantageously employed in many applications as would be apparent to one skilled in the art.

What Is Claimed Is:

- 1 1. A magnetic recording head for at least one of reading from and writing to a medium
2 moving across the head, comprising:
 - 3 a substrate;
 - 4 a closure separated from said substrate by a gap, said closure including
 - 5 a C-core;
 - 6 a thin film layer deposited on said substrate; and
 - 7 one or more gluing vias trenched in a side surface of either or both of said substrate and
 - 8 said closure.
- 1 2. A magnetic recording head according to claim 1, wherein said thin film layer comprises a
2 recording track layer.
- 1 3. A magnetic recording head according to claim 2, wherein said recording track layer
2 comprises at least one of a read track and a write track.
- 1 4. A magnetic recording head according to claim 3, wherein at least one of said gluing vias
2 are trenched on said side surface of said substrate between said at least one read track and write
track
- 1 5. A magnetic recording head according to claim 1 wherein said gluing vias are
2 photolithographically defined and subsequently trenched on said side surfaces.
- 1 6. A magnetic tape head for reading from and writing to a magnetic tape moving across the
2 head, comprising:
 - 3 a substrate having a gap side surface;
 - 4 a closure having a gap side surface that opposes and is separated from said gap side
 - 5 surface of said substrate by a gap;
 - 6 a thin film layer deposited on said gap side surface of said substrate in said gap, wherein
 - 7 said thin film layer has a nonplanar topography along said gap;
 - 8 one or more gluing vias on either or both of said substrate and said closure; and
 - adhesive in said gap and said gluing vias.

1 7. A magnetic tape head according to claim 6, wherein said thin film layer comprises a
2 recording track layer.

1 8. A magnetic tape head according to claim 7, wherein said recording track layer comprises
2 at least one of a read track and a write track.

1 9. A magnetic tape head according to claim 8 wherein at least one of said gluing vias are
2 trenched on said side surface of said substrate between said at least one read track and write
3 track

1 10. A magnetic recording head according to claim 6 wherein said gluing vias are
2 photolithographically defined and subsequently trenched on one or both of said gap side surfaces
3 of said substrate and said closure.

1 11. A method of manufacturing a multi-track tape head for at least one of reading from and
2 writing to a medium comprising the steps of:

3 depositing a recording track layer on a substrate;
4 trenching gluing vias on a gap side surface of either or both of said substrate and a
5 closure; and
6 bonding said substrate and said closure together by introducing adhesive into said gluing
7 vias.

1 12. A method according to claim 11, wherein said step of forming said recording track
2 comprises forming at least one of a read track and a write track on said substrate.

1 13. A method according to claim 11, wherein said step of trenching includes the step of
2 photolithographically defining said gluing vias.

1 14. A method according to claim 11 further including the step of machining a C-core on said
2 gap side surface of said closure.

Abstract of the Disclosure

1 A method and apparatus including gluing vias in the closure surface and/or the recording module
2 surface to increase bonding strength of the closure to the recording module. The surface of the
3 recording module has a nonplanar topography along a gap side surface which creates localized
4 air space in the gap. When adhesive is introduced between the closure and the recording module,
5 the adhesive flows into these air spaces to bond the surfaces. The invention utilizes gluing vias
6 in the surfaces of the closure and/or the recording module to increase flow of the adhesive and
7 improve bonding strength.

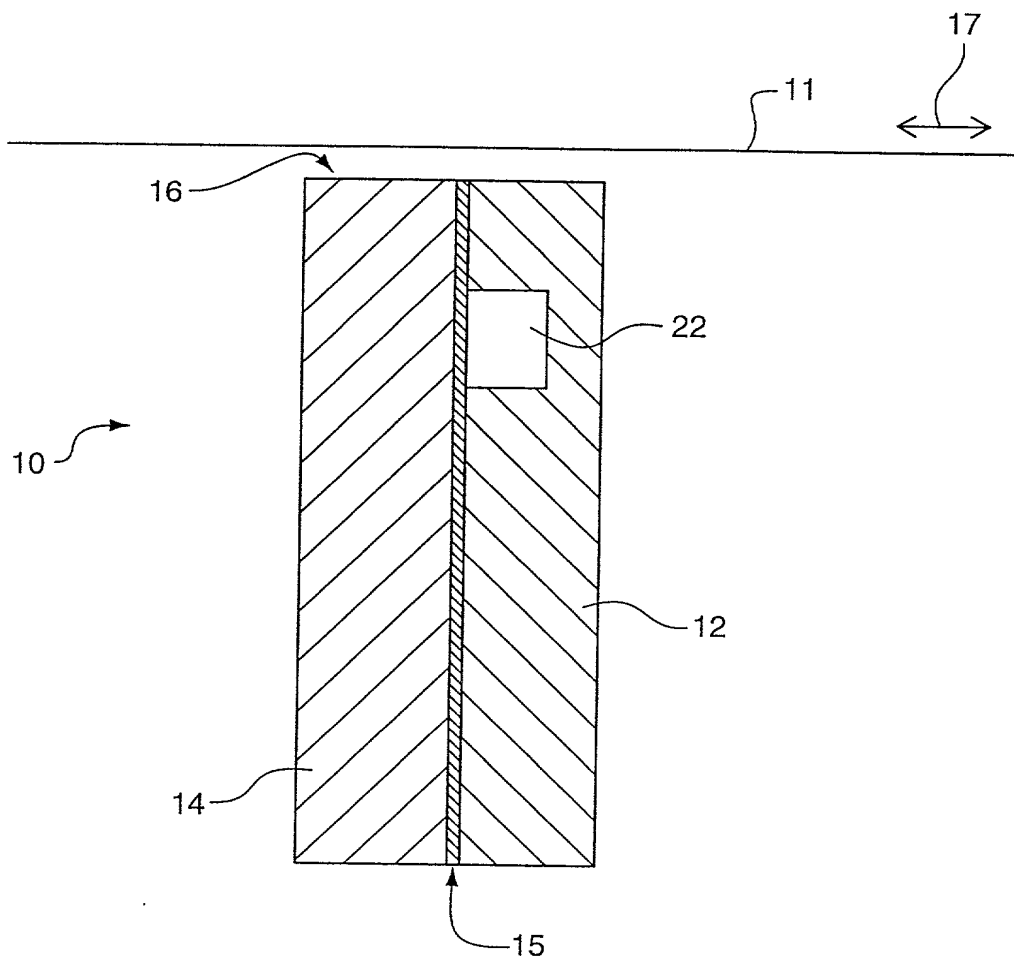


FIG. 1

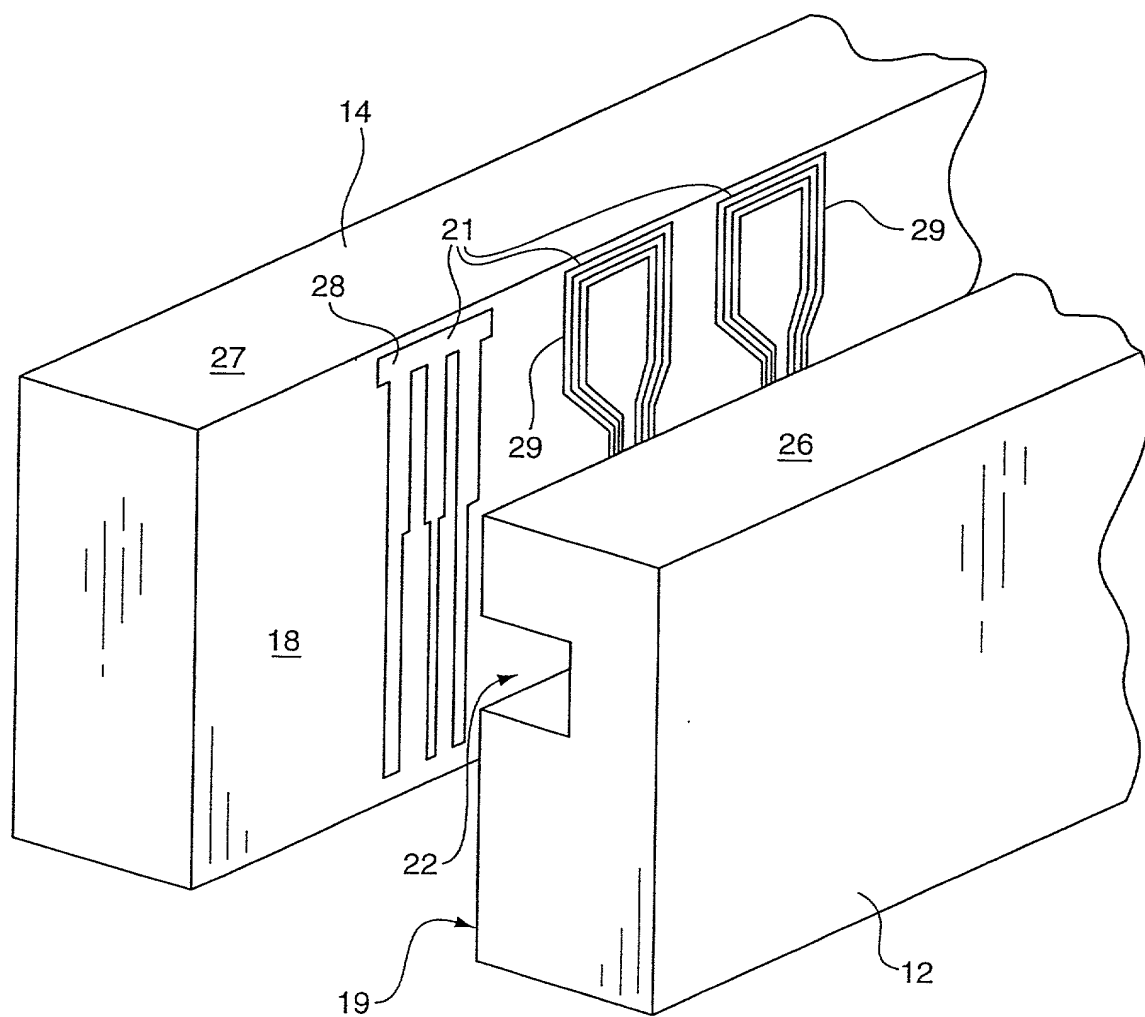


FIG. 2

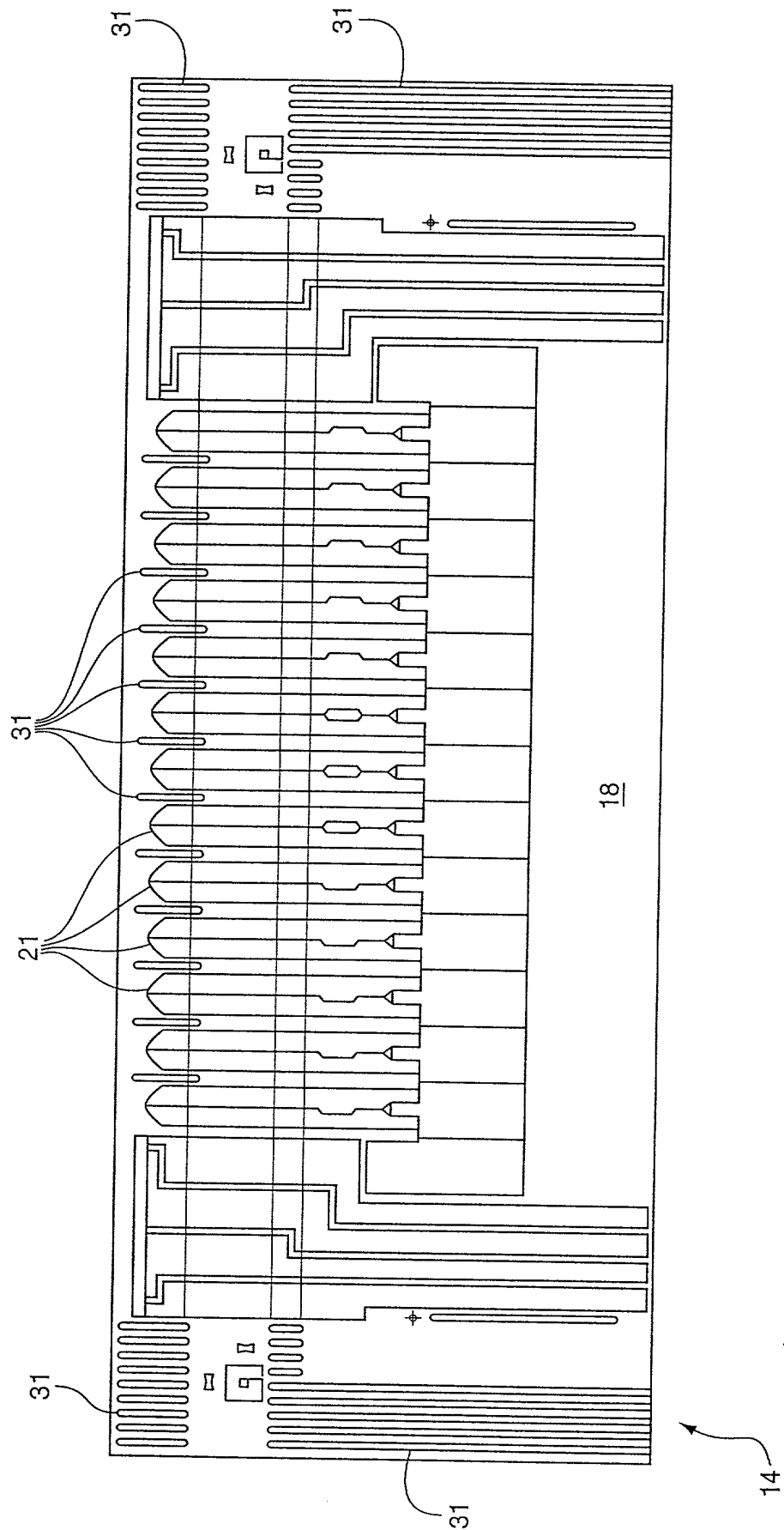


FIG. 3

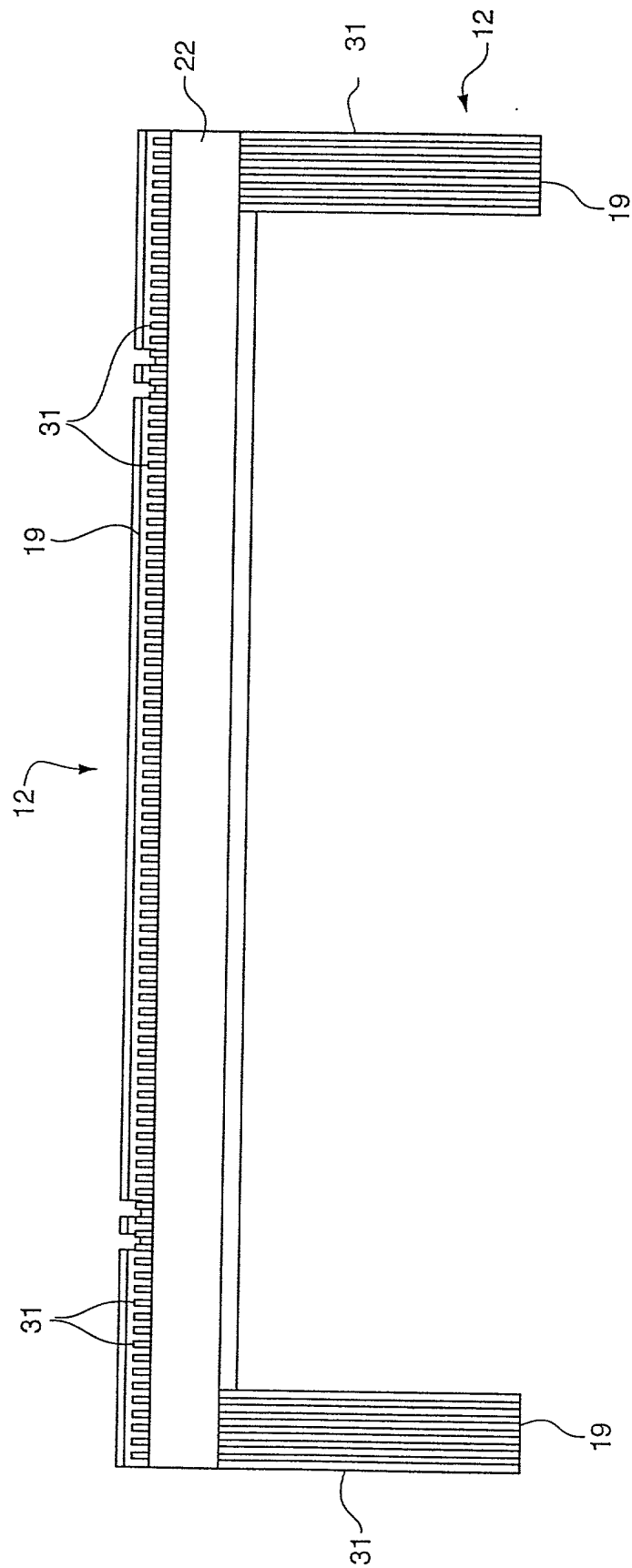
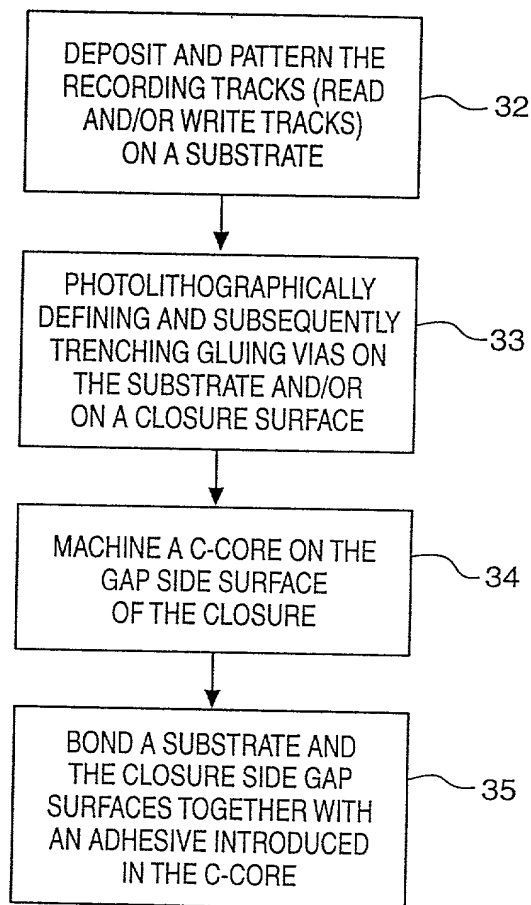


FIG. 4

FIG. 5



DECLARATION FOR PATENT APPLICATION

As a below named inventor, I hereby declare that my residence, post office address, and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor of the subject matter which is claimed and for which a patent is sought on the invention entitled: **"Method and Apparatus For Securing A Thin Film Magnetic Tape Head Closure"**, the specification of which (check one):

☒ is attached hereto

☐ was filed on _____ as Application Serial No. _____ and was amended on _____ (if applicable).

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, §1.56(a).

I hereby claim foreign priority benefits under Title 35, United States Code, §119, of any foreign application(s) for patent or inventor's certificate listed below and also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application which priority is claimed:

Prior Foreign Application(s):Priority Claimed?

(Number)	(Country)	(Day/Month/Year Filed)	[<input type="checkbox"/>] Yes	[<input type="checkbox"/>] No
(Number)	(Country)	(Day/Month/Year Filed)	[<input type="checkbox"/>] Yes	[<input type="checkbox"/>] No

I hereby claim the benefit under Title 35, United States Code, §120, of any United States application(s) listed below and insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, §112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, §1.56(a), which occurred between the filing date of the prior application and the national or PCT international filing date of this application:

(Application Serial No.)	(Filing Date)	(Status: Patented, Pending, Abandoned)
(Application Serial No.)	(Filing Date)	(Status: Patented, Pending, Abandoned)

I hereby appoint the following attorney(s) and/or agents(s) to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith:

Timothy R. Schulte, Reg. No. 29,013

Address all correspondence and telephone calls to Timothy R. Schulte at Storage Technology Corporation, 2270 South 88th Street MS-4309, Louisville, CO 80028 (303) 673-5989.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further, that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Full name of inventor: Yi-Shung Chaug

Inventor's signature: Yi-Shung Chaug Date: 5/1/97

Post Office Address: same Citizenship: U.S.A.

Residence: 1486 Lodge Court, Boulder, Colorado 80303

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of: Yi-Shung Chaug

For: APPARATUS FOR SECURING A THIN FILM MAGNETIC TAPE HEAD
CLOSURE USING BLUING VIAS

Attorney Docket No.: 96-017-TAX

ASSOCIATE POWER OF ATTORNEY

Assistant Commissioner for Patents
Washington, D.C. 20231

Sir:

Please recognize the following attorney as Associate Attorney in this case:

Wayne P. Bailey, Registration No. 34,289

with an address of:

Storage Technology Corporation
One StorageTek Drive, MS-4309
Louisville, Colorado 80028-4309

Respectfully submitted,

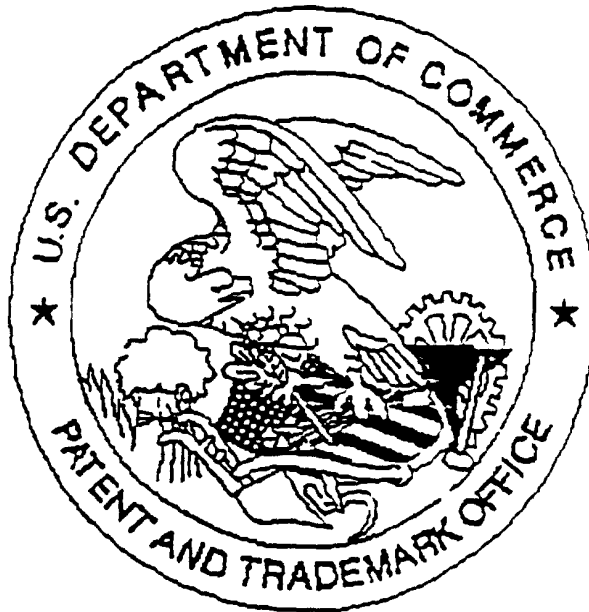
Storage Technology Corporation

By: 

Timothy R. Schulte
Registration No. 29,013

Dated: May 12, 1999.

United States Patent & Trademark Office
Office of Initial Patent Examination – Scanning Division



SCANNED

Application deficiencies were found during scanning:

☒ Page(s) 4, 5 & 9 of specification were not present
for scanning. (Document title)

☐ Page(s) _____ of _____ were not present
for scanning. (Document title)

☐ Scanned copy is best available.